Chapter II

POPULATION

The exposed population, termed "Ranch Hand", was defined as those individuals who were formally assigned to the USAF organizations responsible for the aerial dissemination of herbicides and insecticides in the Republic of Vietnam from 1962 through 1971. These individuals were identified from historical data sources (morning reports, military personnel records, and historical computer tapes) at the National Personnel Records Center (NPRC), St. Louis, Missouri and the USAF Human Resources Laboratory, Brooks Air Force Base, Texas. A total of 1264 Ranch Hand personnel were identified through this initial process. The comparison population was defined as those individuals who were assigned to a variety of cargo-mission organizations throughout Southeast Asia during the same time period. Cargo-mission aircrew members and support personnel were selected because of sufficient population size, similar training and military background experiences, and psychological similarities to the Ranch Hand group. The comparison population was not occupationally exposed to herbicides or insecticides in the Republic of Vietnam. Identification of this population (24,971 individuals) was completed using the same historical data sources as were used to identify the Ranch Hand population.

1. Original Match

Before matching the Ranch Hand and comparison populations, all individuals killed in action (KIA) were removed from the data base. The rationale for their removal is the assumption that combat death in the Ranch Hand group was independent of herbicide exposure. Twenty-two Ranch Handers were identified as KIA. KIA's were also removed from the comparison group for comparability purposes. The remaining Ranch Hand population was matched to the comparison population with an iterative nearest-neighbor computer program (Lathrop, Wolfe, Albanese, Moynahan, 1982). This procedure attempted to match 10 comparison individuals with each Ranch Hander to the closest month of birth, race (Black versus non-Black), and occupational code (1-officer--pilot, 2-officer--navigator, 3-officer--nonflying, 4-enlisted--flyer, and 5-enlisted--ground). Table II-1 presents the total number of study participants by occupation code, and race.

Table II-1

DISTRIBUTION OF THE INITIALLY MATCHED STUDY POPULATION BY OCCUPATION AND RACE

Occupation Code		Number Ranch Hand	Number Comparisons
Non-Black			
1 - Officer-Pilot		349	3318
2 - Officer-Navigator		78	780
3 - Officer-Nonflying		25	250
4 - Enlisted-Flyer		187	1871
5 - Enlisted-Ground		528	5277
	Subtotal	1167	11,496
Black			
1 - Officer-Pilot		6	16
2 - Officer-Navigator		2	20
3 - Officer-Nonflying		1	5
4 - Enlisted-Flyer		15	146
5 - Enlisted-Ground		51	510
	Subtotal	75	697
TOTAL		1242	12,193

The total Ranch Hand population consists of 37% officers and 63% enlisted personnel. Seventy-seven percent of the total Ranch Hand officer population are pilots, 17% navigators, and 6% other officers; 26% of the total Ranch Hand enlisted population are flight engineers and 74% are enlisted nonflying personnel.

Following the match, the majority of Ranch Handers had 10 comparisons. The exceptions were the non-Black pilots who had a mean of only 9.5 comparisons per exposed individual due to the extreme ages of several individuals, and the Black pilots and other Black officers who had means of 2.7 and 5.0 comparisons, respectively. Six percent of the exposed population was found to be Black and 88% of this population was enlisted. Of these enlisted personnel 77% were occupational code 5, Enlisted - Other. All subjects are males. The mean age of the study subjects is approximately 45 years.

2. Ineligibility

In December 1981, the USAF Principal Investigators were advised by the questionnaire contractor that several comparison subjects had reported no experience in Southeast Asia, suggesting that inappropriate selection of some comparison subjects had occurred. Manual review of the comparison populations

military personnel records revealed that 18% of the 12,193 comparison individuals in the original match were indeed ineligible for study. The inadvertent inclusion of several non-Southeast Asia military organizations had resulted in the selection of these inappropriate individuals. The percent loss to the total 1:10 matched comparison population due to ineligibility by occupation code, race, and average age is presented in Table II-2.

Table II-2

PERCENT INELIGIBLE BY OCCUPATION CODE AND RACE,
WITH AVERAGE AGE OF INELIGIBLES BY OCCUPATION CODE

Race	Percent Loss and Occupation Code Counts of Ineligible Comparisons											
	1		2		3		4		5		TOTAL	
Non-Black	(12%)	414	(12%)	90	(34%)	84	(12%)	230	(24%)	1254	(18%)	2072
Black	(13%)	2	(5%)	1	(60%)	3	(10%)	15	(23%)	115	(20%)	136
Total	(12%)	416	(11%)	91	(34%)	87	(12%)	245	(24%)	1369	(18%)	2208
Average Age in Years (as of Nov 83)		48		48		46		48		42		44

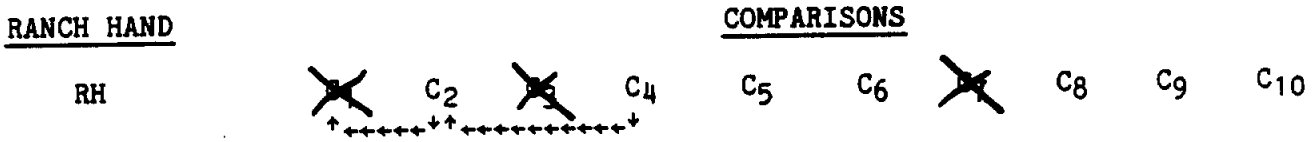
Table II-2 shows that of the 18% loss to the total matched population 18% occurred in the non-Black and 20% occurred in the Black population subsets. Thirty-four percent of all participants in occupation code 3 (nonflying officer) and 24% in occupation code 5 (nonflying enlisted) were lost due to ineligibility. The losses from occupation code 5 clearly exceed the losses in the other 4 categories. The nonflying enlisted individuals were on average the youngest (42 years) while the flying officer and flying enlisted categories were on average the oldest (48 years).

A full log-linear analysis (see chapter VII) with all three matching variables included simultaneously was not performed because of the many small cell counts involved. A log-linear model fitted to the three-way frequency table based on eligibility, occupation code, and race, revealed a significant association of eligibility with occupation code ($P<.001$, adjusted), but not with race ($P=.41$, adjusted).

Because the comparison ineligibility problem was identified after the morbidity study questionnaire and physical examination contracts had been implemented, the ineligible comparisons were removed from the matched cohort and the remaining comparison matrix was collapsed to fill the vacancies created by these removals. This process is characterized in Figure II-1.

Figure II-1

REMOVAL OF THE INELIGIBLE COMPARISONS
AND THE SHIFT LEFT



This figure shows a hypothetical Ranch Hander (RH) and his 10 comparison subjects (C_1-C_{10}). The C_1, C_3 and C_7 were found to be ineligible and removed. All remaining eligibles were then shifted to the left, i.e., C_2 became C_1, C_4 became C_2, etc. Following the removal of all ineligible subjects, the study was reduced to a 1:8 design. The ineligible selection, the shift left and the subsequent comparison population reduction was presented to the Advisory Committee in 1982. This group felt that the impact of group ineligibility on the study design was negligible; however, subsequent analysis demonstrated a potential impact on inferential reliability (See Chapter V, Compliance and Bias). Statistical considerations required that the shifted population be flagged and analyzed independently of the original comparisons. The data in this report have been primarily analyzed using the original comparisons in an attempt to best describe potential herbicide effects. Wherever possible, analyses using the entire comparison population are also included.

During the conduct of the initial morbidity study 5 additional Ranch Handers were identified through personnel record sources and Veterans Administration Education Benefits and Financial Records. These 5 individuals had not been identified earlier because the majority of their military personnel records had been destroyed in a fire at the NPRC in St. Louis. Three of these 5 were newly discovered Ranch Handers and 2 were comparisons who were subsequently identified as Ranch Handers. Ten additional Ranch Handers were identified following the completion of the morbidity study. These individuals will be included in the follow-up study. No attempt was made to select comparisons for these new Ranch Handers. During the removal of ineligible subjects, 1 Ranch Hander, a Black officer pilot, lost his only comparison and remains unmatched, giving a total of 16 unmatched Ranch Handers, of which 6 are in this study.

At the time of morbidity study implementation there were 1,241 Ranch Handers matched to 1,026 original and 212 shifted comparisons. Three eligible shifted comparisons were deleted following data collection. The comparison population (C_1) eligible for data collection for the baseline morbidity effort is presented in Table II-3 by occupation group and nature of the comparison group, i.e., original or shifted.

Table II-3

COMPARISON POPULATION ELIGIBLE FOR THE MORBIDITY STUDY
BY OCCUPATION CODE AND NATURE OF COMPARISON GROUP
I.E., ORIGINAL OR SHIFTED (C_1)

Occupation Code		Original Comparisons (O)	Shifted Comparisons (S)	Total
Non-Black				
1		307	41	348
2		72	6	78
3		13	12	25
4		169	18	187
5		405	122	527
	Subtotal	966	199	1165
Black				
1		5	0	5
2		2	0	2
3		1	0	1
4		15	0	15
5		37	13	50
	Subtotal	60	13	73
	TOTAL	1026	212	1238

Sixty-four percent of the shifted comparison population is in occupation code 5 (Enlisted-ground). All Black shifted comparisons are in this group, as well.

The study protocol estimated that 39% of the entire Ranch Hand population would complete the physical examination portion of the morbidity study. This initial estimate of compliance was based on an estimate of the influences of status (military active duty, military retired, separated and flying) on the individual who could not be guaranteed confidentiality of medical findings. Status also influenced locatability. Active duty and military retired personnel are located through military data sources, while separated individuals must be located through civilian sources. The status and the flying category of the Ranch Hand and comparison population are presented in Tables II-4 and II-5.

Table II-4

STATUS OF THE RANCH HAND
AND MATCHED MORBIDITY COMPARISON POPULATION (C_1).

Status	Ranch Hand	Comparison		
		Original	Shifted	Total
Active Duty	185	157	27	184
Retired From Military	576	510	85	595
Separated	442	359	100	459
TOTAL	1203*	1026	212	1238

*39 Ranch Hands were deceased at the initiation of the morbidity study.

Table II-4 demonstrates that 48% of the population is retired from the military; 15% remain on active duty; and 37% are separated. Those individuals currently holding military or civilian flying certificates are presented in Table II-5.

Table II-5

COUNTS OF THE INDIVIDUALS HOLDING MILITARY AND CIVILIAN
FLYING CERTIFICATES, THE RANCH HAND AND MATCHED COMPARISON POPULATION (C_1)

Status	Ranch Hand	Comparison		
		Original	Shifted	Total
Military Flying	82	78	12	90
Federal Aviation Admin Certificate	128	128	16	144
TOTAL	210	206	28	234

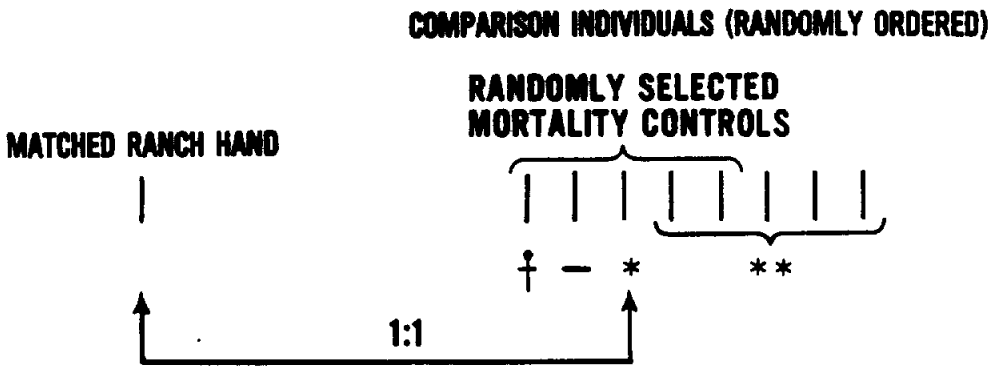
This table shows that 17% (210/1203) of the Ranch Handers and 19% (234/1238) of the total C_1 population presently have military aviation codes or Federal Aviation Administration (FAA) certificates that define active participation in aviation. Twenty percent (206/1026) of the original and 13% (28/212) of the shifted comparison population hold FAA certificates.

3. Study Selection

The study protocol defines the morbidity population as all living Ranch Handers and their first randomly selected, alive and compliant comparison. The selection procedure for the questionnaire and physical examination is presented in Figure II-2.

Figure II-2

SELECTION PROCEDURE FOR THE QUESTIONNAIRE, PHYSICAL EXAMINATION, AND FOLLOW UP STUDY



† DEAD
— UNWILLING
* VOLUNTEER
** REPLACEMENT CANDIDATES

In this example, the first randomly ordered comparison was found to be dead. The second was contacted but unwilling to participate, and the third volunteered to participate in the morbidity study. This process resulted in a third comparison subset, the replacement population. As shown in Figure II-2, this population resulted from the refusal of the original and shifted comparisons to participate in the morbidity study. The study protocol required that the replacement comparisons be matched to the noncompliant individuals on health perception and that they be treated separately in the statistical analyses. In actuality, they were not matched on health perception but were the first volunteers in the randomly ordered mortality sets following original comparison refusals. Because the health perception of the replacement was not matched to the original, comparison subject data analyses and inferences based on these analyses will only be reported for the original and total comparison populations. In this design, deceased Ranch Handers cannot be replaced for physical exam, while deceased comparisons can be replaced due to the one-many matching. This disparity could lead to inferential bias if cause-specific death rates differ in the two groups. Thus far, these rates are not significantly different.

This epidemiologic study was designed as a matched cohort design. There were 1241 Ranch Handers matched to comparisons by age, race and occupational category at the initiation of the morbidity study. The matched comparison population consisted of 1026 original and 212 shifted comparisons. Three ineligible shifted comparisons were deleted following data collection. The shifted group resulted from inappropriate selection, removal, and shifting left of the comparison population. Additionally there were 16 Ranch Handers who could not be matched. Ninety-four percent (1171/1247) of the study population is non-Black. The average age of the population is 45 years and 15% (185/1203) remain on active duty. Eighteen percent (210/1203) of the Ranch Handers and 19% (234/1238) of the total comparison group have either military flying duties or FAA certificates that denote active participation in aviation. There were 39 known deceased Ranch Handers. As a study requirement, all morbidity study comparisons were alive at the initiation of the morbidity effort. In summary, 1208 living Ranch Handers and 1238 original and shifted comparisons were entered into the morbidity study.